

The background of the slide is a composite image of space exploration. On the left, a large, detailed Earth is shown. To its right is a smaller, reddish planet, likely Mars. A small spacecraft is depicted in the distance, emitting a bright blue beam of light. The sky is a deep blue with numerous stars. In the bottom right corner, there is a black silhouette of a person's head and shoulders, looking towards the left. The overall theme is space exploration and technology.

EXPLORESpace TECH  
TECHNOLOGY DRIVES EXPLORATION

# NASA Lunar Surface Innovation Initiative: Ensuring a Cohesive, Executable Strategy for Technology

*International Astronautical Congress*

STMD Deputy Associate Administrator: Prasun Desai

September 19, 2022



# SPACE TECHNOLOGY PORTFOLIO

## EARLY STAGE INNOVATION AND PARTNERSHIPS

- Early Stage Innovation
  - Space Tech Research Grants
  - Center Innovation Fund
  - Early Career Initiative
  - Prizes, Challenges & Crowdsourcing
  - NASA Innovation Advanced Concepts
- Technology Transfer

## SBIR/STTR PROGRAMS

- Small Business Innovation Research
- Small Business Technology Transfer

## TECHNOLOGY MATURATION

- Game Changing Development
- Lunar Surface Innovation Initiative

## TECHNOLOGY DEMONSTRATION

- Technology Demonstration Missions
- Small Spacecraft Technology
- Flight Opportunities

Technology Drives Exploration

LOW MID HIGH

Technology Readiness Level



# Lunar Surface Innovation Initiative (LSII)

LSII works across industry, academia and government through in-house efforts and partnerships to develop transformative capabilities for lunar surface exploration.

- Formulate and integrate technology maturation activities across the TRL pipeline and space technology programs
- Leverage innovative partnering and procurement approaches to expedite technology development
- Utilize early robotic lunar surface flight opportunities to inform key technology development
- Establish the Lunar Surface Innovation Consortium (LSIC)

**Extreme Access**



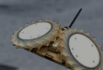
**Extreme Environments**



**Lunar Dust Mitigation**



**Sustainable Power**



**Surface Excavation & Construction**



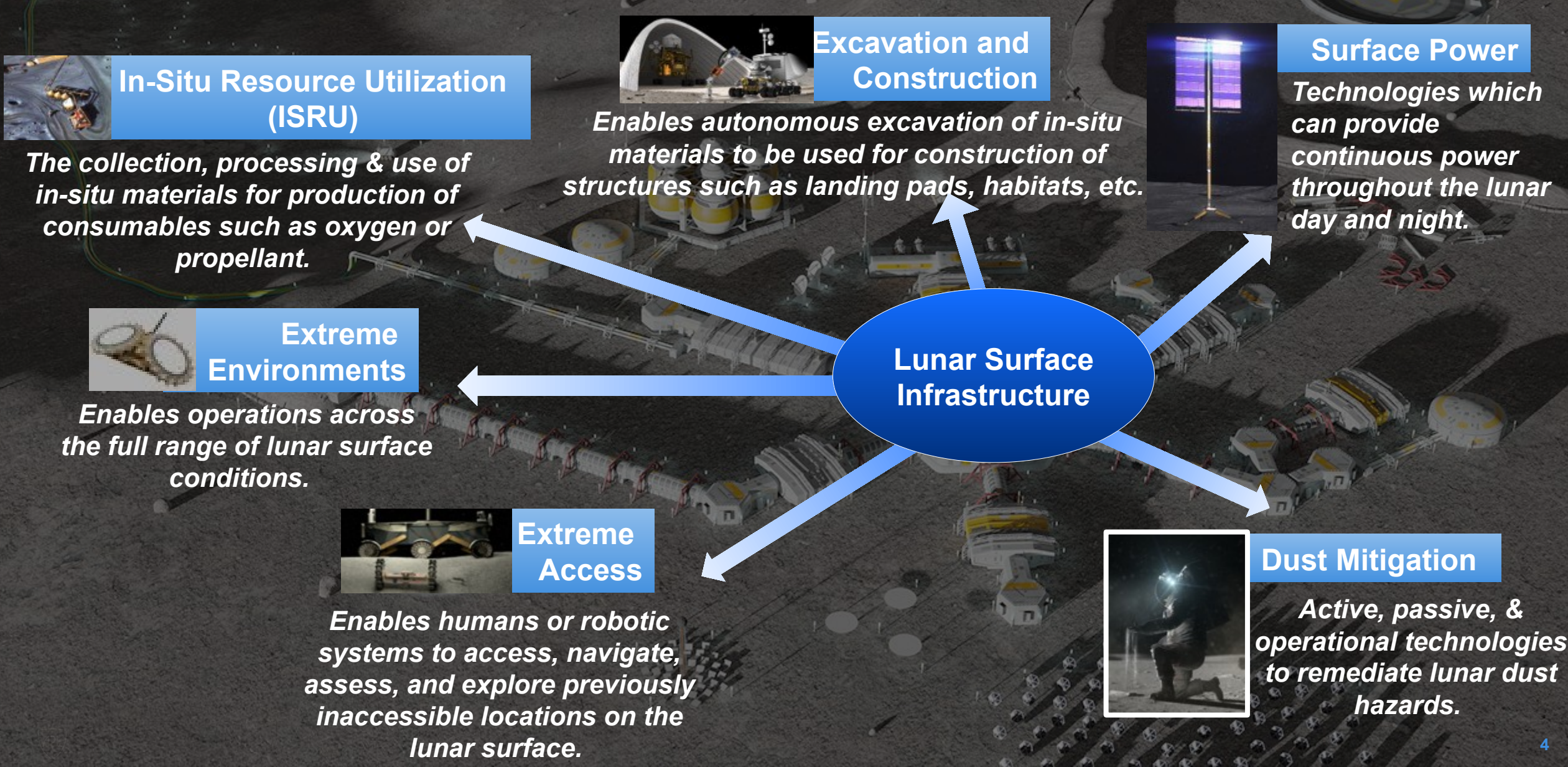
**In-Situ Resource Utilization**





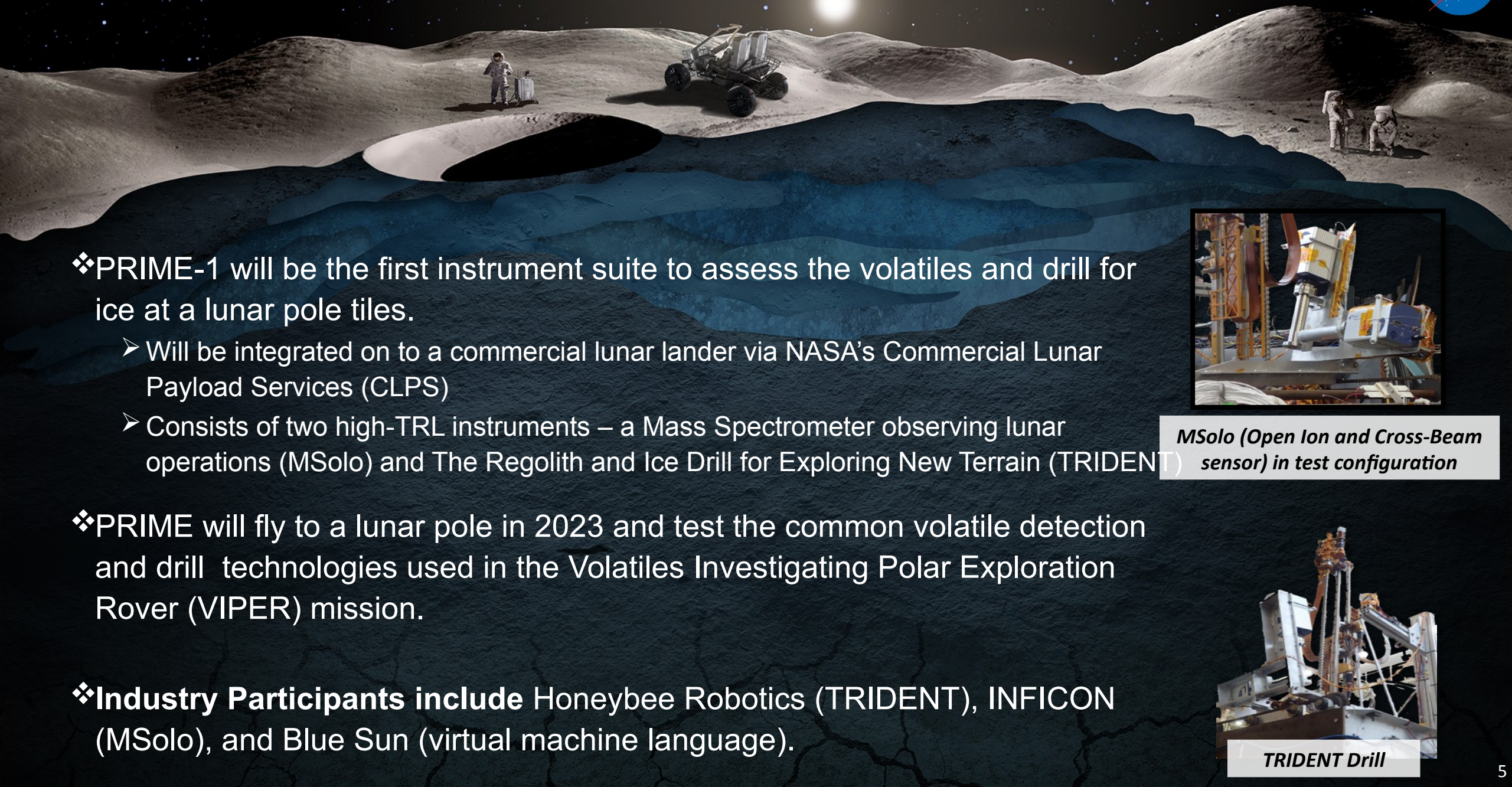
# LSII Capability Areas

Six capability areas focused on increasing technology readiness for lunar surface infrastructure





# Polar Resources Ice Mining Experiment-1 (PRIME-1)



❖ PRIME-1 will be the first instrument suite to assess the volatiles and drill for ice at a lunar pole tiles.

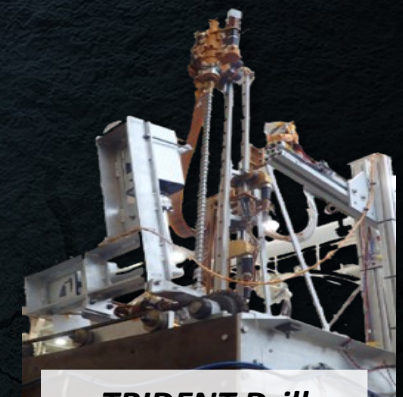
- Will be integrated on to a commercial lunar lander via NASA's Commercial Lunar Payload Services (CLPS)
- Consists of two high-TRL instruments – a Mass Spectrometer observing lunar operations (MSolo) and The Regolith and Ice Drill for Exploring New Terrain (TRIDENT)



*MSolo (Open Ion and Cross-Beam sensor) in test configuration*

❖ PRIME will fly to a lunar pole in 2023 and test the common volatile detection and drill technologies used in the Volatiles Investigating Polar Exploration Rover (VIPER) mission.

❖ **Industry Participants include** Honeybee Robotics (TRIDENT), INFICON (MSolo), and Blue Sun (virtual machine language).



*TRIDENT Drill*



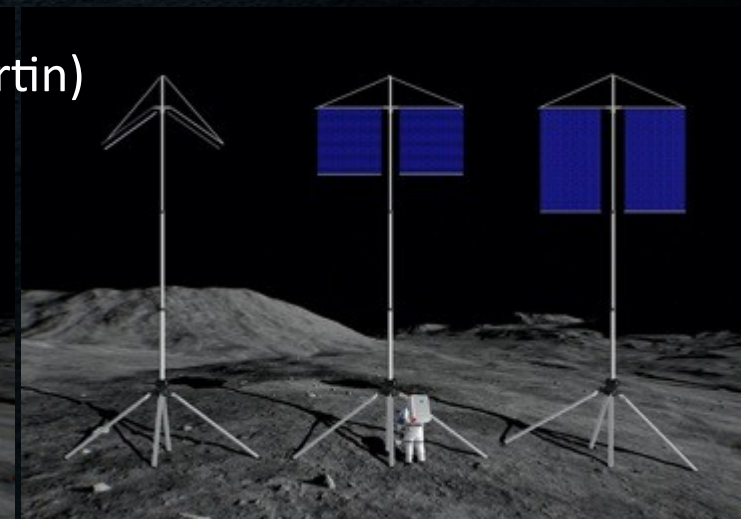
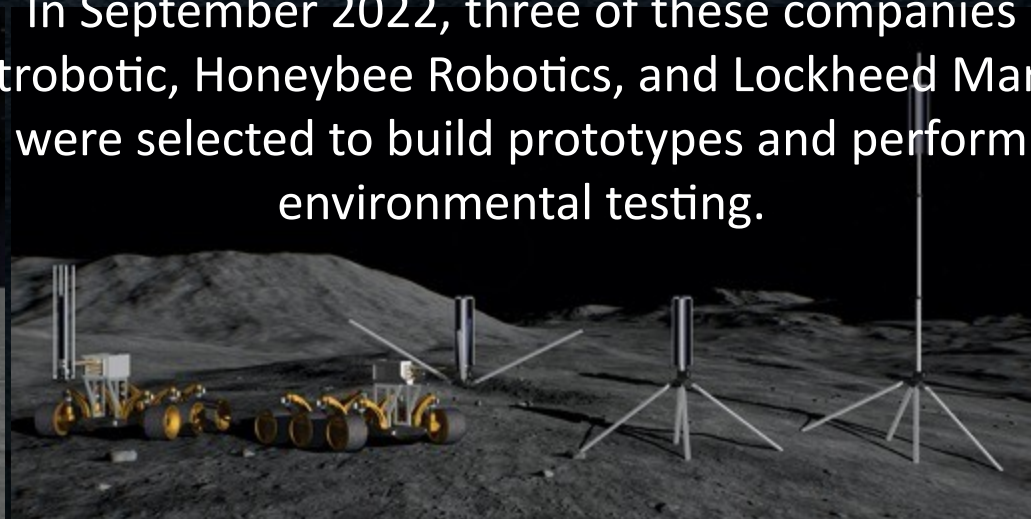
# Lunar Vertical Solar Array Technology (VSAT)

*Local power will be a critical component for a sustained presence on the lunar surface.*

- An autonomous system capable of vertical array deployment of a mast up to 10 m on uneven terrain in order minimize shadowing in order to capture near-continuous sunlight at the lunar South pole.
- Designed for reliable, autonomous retraction and system mobility with minimal mass and packing volume.

Parameters	Goals
Array Power	10 kW
Terrain Stability	15 incline with 10m mast
Mass Height	10 meters
Autonomous Deployment and Retraction	10 Deployment/Retraction Cycles in lunar gravity

In September 2022, three of these companies (Astrobotic, Honeybee Robotics, and Lockheed Martin) were selected to build prototypes and perform environmental testing.



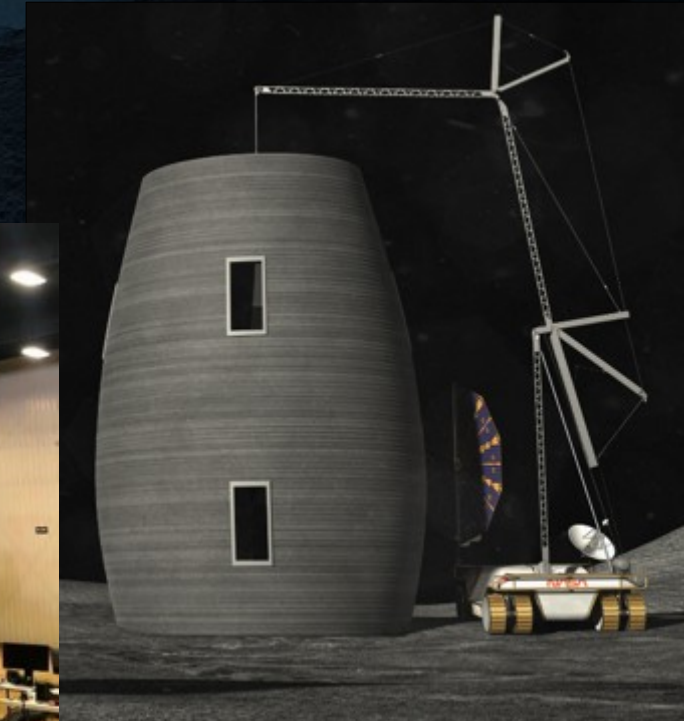


# Moon-to Mars Planetary Autonomous Construction Technology (MMPACT)



*Structures will be needed to provide protection of crew members, hardware and electronics on the surface.*

- Develop, deliver, and demonstrate on-demand capabilities to protect crewmembers and hardware, and create infrastructure on the lunar surface via construction of landing pads, habitats, shelters, roadways, berms and blast shields using lunar regolith-based materials.
- Partners: ICON, SEArch+, USAF, Defense Innovation Unit, Texas Air National Guard



# LSII - Developing capabilities through collaborations



LSII has awarded ~\$265M to industry and academia through Space Tech Programs since 2020

## Collaborations & Partnerships



Commercial Lunar Payload Services (CLPS) Flight Demonstrations



Tipping Point Partnerships & Collaborative Opportunities



APL LSII Integration and Lunar Surface Innovation Consortium (LSII)



Vertical Solar Array Technology (VSAT) Prototype Solicitation



SBIRs (Ph. I, II, III, CCRPP, Lunar Sequentials)



Breakthrough Innovative Game-changing (BIG) University Challenge



Space Technology Research Grants (New LuSTR, ECF, ESI Grant Opportunities)



NASA Tournament Lab Crowdsourcing (GrabCAD, Yet2, HeroX)



NASA Innovative Advanced Concepts (NIAC)



Centennial Challenges ('Watts on the Moon' & 'Break the Ice' Challenges)



# Upcoming Lunar Surface Technology Demonstrations



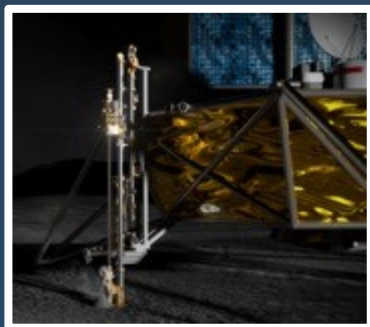
Lunar surface demonstrations, via the Commercial Lunar Payload Services (CLPS) initiative, are key opportunities to mature the key capabilities required for for NASA and industry.

## Astrobotic Peregrine-1 (Astrobotic)

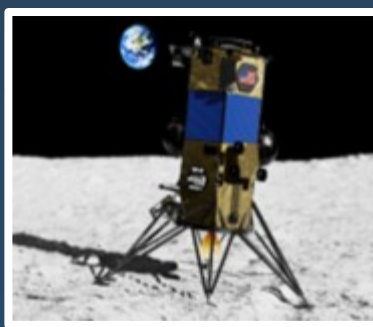


Astrobotic Terrain  
Relative Navigation  
(ATRN) – Tipping Point

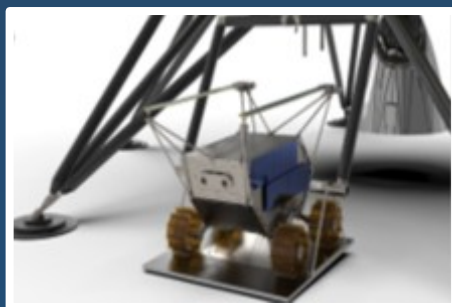
## CLPS PRIME (Intuitive Machines-2)



Deployable Lunar  
Hopper (STMD Tipping  
Point)

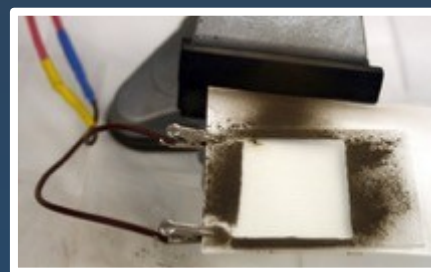


Polar Resources Ice-  
Mining Experiment (PRIME-1)



Nokia 4G/LTE Proximity Comms  
(STMD Tipping Point)

## CLPS 19D (Firefly Aerospace)



Electrodynamic Dust Shield



Stereo Camera for Lunar Plume  
Surface Studies (SCALPSS 1.1)

## CLPS CP-11 (Intuitive Machines-3)



Cooperative Autonomous  
Distributed Robotic Explorers  
(CADRE)





# Lunar Surface Innovation Consortium (LSIC)



Nationwide alliance of universities, commercial companies, non-profit research institutions, NASA, and Other Government Agencies with a vested interest in our nation's campaign to establish a sustained presence on the Moon.

## LSIC Objectives include:

- Identifying lunar surface technology needs and assessing the readiness of relative systems and components
- Making recommendations for a cohesive, executable strategy for development and deployment of the technologies required for successful lunar surface exploration
- Providing a central resource for gathering information, analytical integration of lunar surface technology demonstration interfaces, and sharing of results.

## Focus Groups (FG) are the primary means for consistent interaction with the LSIC Community. This includes:

- Establishing collaborative relationships among members via virtual monthly forums, quarterly virtual workshops, and LSIC member site visits
- Building community and developing talent
- Compiling member input and reporting outcomes and recommendations



*If interested in further information, please visit [lsic.jhuapl.edu](http://lsic.jhuapl.edu)*





# Lunar Surface innovation Consortium Impacts....

LSIC has engaged a network of industry, academia and other government agencies from 50 states, D.C., Guam, Puerto Rico and 46 countries through Bi-annual meetings, Monthly LSII Capability Focus Group meetings and themed workshops.

## 5 Bi-annual Meetings

- Attended by over 2,000 people
- 54% at kickoff had not previously worked with NASA Space Tech

## 1500 People attended 6 Thematic Workshops

- Topics driven by member interest
- Key takeaways and recommendations provided in Outcome Report

## 6 Focus Groups

- Virtual Monthly meetings
- Averaging 100 people per meeting
- 35 Subgroups defined and led by members
- Collaboration Space
- Provides feedback and recommendations to NASA

## 678 Organizations working toward one goal

- Monthly Newsletter
- Technology Assessments Reports
- Lunar Simulants Portal
- LSIC website

## Upcoming Events

Nov 2-3

LSIC Fall Meeting @ University of Texas El Paso

[lsic.jhuapl.edu](http://lsic.jhuapl.edu)





Technology Drives Exploration